COMPLETE LISTING OF THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1-20. (previously cancelled)

21. (previously presented) A portable power tool having an output spindle, an electric motor for driving the output spindle and a control system for controlling the operation of the motor including a power source and a power switching device interconnecting the power source to the motor for applying a constant frequency PWM drive signal from the power source to the motor, and a controller for controlling the power switching device and monitoring at least one operating characteristic of the power tool and reducing the frequency of said PWM drive signal in response to a predetermined change in said operating characteristic to thereby cause said power tool to enter a ratchet mode of operation.

22. (previously presented) The power tool of claim 21 wherein said frequency of said PWM drive signal is reduced to a frequency less than 50 Hz.

23. (previously presented) The power tool of claim 22 wherein said operating characteristic is motor current.

24. (previously presented) The power tool of claim 23 wherein said predetermined change is an increase in motor current above a predetermined threshold.

25. (previously presented) The power tool of claim 23 wherein said predetermined change corresponds to a rate of increase in motor current above a predetermined threshold.

26. (previously presented) The power tool of claim 22 wherein said operating characteristic is the speed of the motor.

27. (previously presented) The power tool of claim 26 wherein said predetermined change is a decrease in the speed of the motor below a predetermined threshold.

28. (previously presented) The power tool of claim 26 wherein said predetermined change corresponds to a deceleration rate in the speed of the motor below a predetermined threshold.

29. (previously presented) The power tool of claim 22 further including an operator actuable trigger switch and wherein said controller further controls the amount of power supplied to the motor by varying the duty cycle of the PWM drive signal in accordance with the actuated position of said trigger switch.

30. (previously presented) The power tool of claim 21 wherein said power source is a battery.

31. (previously presented) A control system for a portable power tool having an output spindle driven by an electric motor of the type that is responsive to the total power

supplied to the motor via a drive signal for controlling the speed of the motor, said drive signal having associated therewith a frequency, the control system comprising:

a power switching device interconnecting the motor to a power source for applying said drive signal to said motor; and

a controller for monitoring an operating characteristic of the power tool and adjusting the frequency of the drive signal in accordance with a predetermined change in said operating characteristic to cause the motor to enter a ratchet mode of operation.

32. (previously presented) The control system of claim 31 wherein said power source is a battery directly coupled to the power tool.

33. (previously presented) The control system of claim 31 wherein said operating characteristic is motor current.

34. (previously presented) The control system of claim 33 wherein said predetermined change is an increase in motor current above a predetermined threshold.

35. (previously presented) The control system of claim 33 wherein said predetermined change corresponds to a rate of increase in motor current above a predetermined threshold.

36. (previously presented) The control system of claim 31 wherein said operating characteristic is the speed of the motor.

37. (previously presented) The control system of claim 36 wherein said predetermined change is a decrease in the speed of the motor below a predetermined threshold.

38. (previously presented) The control system of claim 36 wherein said predetermined change corresponds to a deceleration rate in the speed of the motor below a predetermined threshold.

39. (previously presented) The control system of claim 31 further including an operator actuable trigger switch and wherein said controller further controls the amount of power supplied to the motor by controlling a characteristic of said drive signal in accordance with the actuated position of said trigger switch.

40. (previously presented) The control system of claim 39 wherein said drive signal is a PWM signal and said characteristic of said drive signal is the duty cycle of the PWM signal.

41. (previously presented) The control system of claim 40 wherein said controller reduces the frequency of said PWM drive signal from a relatively high value to a low value less than 50 Hz in response to a predetermined change in said operating characteristic.

42. (previously presented) The control system of claim 41 wherein the frequency of said drive signal is sufficiently low to cause said power tool to enter into a ratchet mode of operation.

43. (previously presented) The control system of claim 42 wherein said power source is a battery directly coupled to the power tool and said PWM drive signal is a d.c. signal.

44. (previously presented) A power tool having an electric motor for driving an output spindle, a first operator actuable device for controlling the amount of power applied to the motor, and a control circuit for modulating the power supplied to the motor in accordance with the actuation of said first operator actuable device; the improvement comprising a second operator actuable device for selectively causing said control circuit to operate the motor in a pulse mode that produces substantial cyclical variations in the torque applied to said output spindle.

45. (previously presented) The power tool of claim 44 wherein said first operator actuable device is a retractable trigger and the control circuit modulates the power supplied to the motor in accordance with the position of the trigger.

46. (previously presented) The power tool of claim 45 wherein said second operator actuable device comprises a switch for selectively switching said control circuit between a first operating mode wherein the modulated power supplied to the motor results in the smooth application of torque to the output spindle and a second pulse mode of operation wherein the power supplied to the motor is interrupted by OFF periods of sufficient duration to cause discontinuous incremental rotation of the output spindle.

47. (previously presented) The power tool of claim 46 wherein said control circuit produces a PWM control signal that is supplied to the motor and further wherein the duty cycle of the PWM control cycle is varied in accordance with the position of the trigger.

48. (previously presented) The power tool of claim 47 wherein said control circuit cycles the power to the motor in said second pulse mode of operation at a frequency of less than 50 Hz.

49. (previously presented) The power tool of claim 47 wherein said switch selectively sets the frequency of said PWM control signal to a relatively high frequency in said first mode of operation and to a relatively low frequency less than 50 Hz in said second pulse mode of operation.

50. (previously presented) A power tool having an electric motor for driving an output spindle, a first operator actuable device having a plurality of settings, and a control circuit connected to said first operator actuable device and to said electric motor, said control circuit controlling the amount of electrical power supplied to the motor by modulating an electrical signal in accordance with the setting of said first operator actuable device; the improvement comprising a second operator actuable device connected to said control circuit for selectively causing said control circuit to operate said motor in a pulse mode by cycling the power supplied to the motor ON and OFF with the intervening OFF periods being of sufficient duration to cause discontinuous incremental rotation of said output spindle.

51. (previously presented) The power tool of claim 50 wherein said first operator actuable device is a retractable trigger and the control circuit modulates the power supplied to the motor in accordance with the position of the trigger.

52. (previously presented) The power tool of claim 51 wherein said second operator actuable device comprises a switch for selectively switching said control circuit between a first operating mode wherein the modulated power supplied to the motor results in

the smooth application of torque to the output spindle and a second operating mode corresponding to said pulse mode.

53. (previously presented) The power tool of claim 52 wherein said OFF periods are of sufficient duration to cause the output spindle under operative load conditions to come to a complete stop between each incremental rotation of the output spindle.

54. (previously presented) The power tool of claim 53 wherein each increment of rotation of said output spindle is less than a full revolution of said output spindle.

55. (previously presented) The power tool of claim 46 wherein said OFF periods are of sufficient duration to cause the output spindle under operative load conditions to come to a complete stop between each incremental rotation of the output spindle.

56. (previously presented) The power tool of claim 55 wherein each increment of rotation of said output spindle is less than a full revolution of said output spindle.

57. (currently amended) A power tool having an electric motor for driving an output spindle having a tool holder operatively coupled thereto, an operator actuable switch for controlling the amount of power applied to the motor, and a control circuit for modulating the power supplied to the motor in accordance with the position of said switch by varying the duty cycle of a constant frequency, pulse width modulated (PWM) direct current (d.c.) control signal generated by the control circuit to thereby control the speed of the motor; the improvement wherein said control circuit further controls the power to the motor, ~~(~~with said switch in a substantially fixed position~~)~~, by cyclically turning the power ON and OFF at a frequency of less than 50 Hz.

58. (previously presented) The power tool of claim 57 wherein said OFF periods are of sufficient duration to cause the output spindle under operative load conditions to come to a complete stop between each incremental rotation of the output spindle.

59. (previously presented) The power tool of claim 58 wherein each increment of rotation of said output spindle is less than a full revolution of said output spindle.

60. (previously presented) A power tool having an electric motor for driving an output spindle having a tool holder operatively coupled thereto, an operator actuable switch for controlling the amount of power applied to the motor, and a control circuit for modulating the power supplied to the motor in accordance with the position of said switch by varying the duty cycle of a constant frequency, pulse width modulated (PWM) direct current (d.c.) control signal generated by the control circuit to thereby control the speed of the motor; the improvement wherein said control circuit in a first operating mode generates said PWM d.c. control signal to cause said motor to provide a substantially smooth application of torque to said output spindle over substantially the entire duty cycle range of said control signal, and in a second operating mode generates said PWM d.c. control signal to cause said motor to provide bursts of torque to said output spindle that produce substantial variation in the speed of rotation of said output spindle between successive bursts of torque.

61. (previously presented) The power tool of claim 60 further including a second operator actuable device for selectively switching said control circuit between said first and second operating modes.

62. (previously presented) The method of claim 61 wherein the output spindle of the tool intermittently comes substantially to a stop under an operative load condition between successive bursts of torque.

63. (previously presented) The method of claim 62 wherein the duration of each of said successive bursts of torque is sufficiently brief in time to produce less than a full revolution of said output spindle.

64. (previously presented) A method of controlling a power tool having an electric motor for driving an output spindle having a tool holder operatively coupled thereto and a control circuit that is responsive to a first operator actuable device for controlling the amount of power applied to the motor, the method comprising the steps of:

modulating the power to the motor in accordance with the position of said first operator actuable device by varying the duty cycle of a constant frequency, pulse width modulated (PWM) direct current (d.c.) control signal generated by the control circuit to thereby control the speed of the motor; and

cyclically turning said PWM d.c. control signal ON and OFF at a sufficiently low frequency to cause the motor to provide bursts of torque to said output spindle that produce substantial variation in the speed of rotation of said output spindle between successive bursts of torque.

65. (previously presented) The method of claim 64 wherein the output spindle of the tool intermittently comes substantially to a stop under an operative load condition between successive bursts of torque.

66. (previously presented) The method of claim 65 wherein the duration of each of said successive bursts of torque is sufficiently brief in time to produce less than a full revolution of said output spindle.

67. (previously presented) In a power tool having an electric motor for driving an output spindle, the method of selectively operating the power tool in either a first mode wherein power is supplied to the motor in a manner that imparts a continuous application of torque to said output spindle, or in a second mode wherein power is supplied to the motor in a manner that imparts a non-uniform application of torque to said output spindle of sufficient variation to cause said output spindle to rotate in a series of discontinuous increments.

68. (previously presented) The method of claim 67 wherein power to the motor in said second mode is applied during a succession of brief periods sufficiently spaced apart in time to enable said output spindle under operative load conditions to come to a substantial stop between successive brief periods.

69. (previously presented) The method of claim 67 wherein each discontinuous increment of rotation is less than a full revolution of said output spindle.

70. (previously presented) In a power tool having an electric motor for driving an output spindle, the method of controlling the electric motor by pulsing the motor so that a series of discontinuous torque bursts are imparted to the output spindle of the tool, said torque bursts causing said output spindle to rotate in a corresponding series of discontinuous increments each of which is less than a full revolution of said output spindle.

71. (previously presented) The method of claim 70 wherein said torque bursts are sufficiently spaced apart in time to enable said output spindle under operative load conditions to come to a substantial stop between successive torque bursts.

72. (previously presented) In a power tool having an electric motor for driving an output spindle, the method of selectively operating the power tool in either a first mode wherein power is supplied to the motor in a manner that imparts a continuous application of torque to said output spindle, or in a second mode wherein power is supplied to the motor in a manner that imparts bursts of torque to said output spindle that produce substantial variation in the speed of rotation of said output spindle between successive bursts of torque.

73. (previously presented) The method of claim 72 wherein the duration of each of said successive bursts of torque is sufficiently brief in time to produce incremental rotation less than a full revolution of said output spindle.

74. (previously presented) The method of claim 73 wherein each increment of rotation is less than or equal to one-half turn of said output spindle.

75. (previously presented) The method of claim 72 wherein the output spindle of the tool intermittently comes substantially to a stop under an operative load condition between successive bursts of torque.

76. (previously presented) A portable power tool having an output spindle, an electric motor for driving the output spindle, and a control circuit for controlling the operation of the motor including a power switching device interconnecting a power source to the motor for controlling the application of power to the motor, said control circuit producing a drive signal that

is supplied to said power switching device to control the operation of said power switching device so that the motor drives the output spindle in a pulse mode that causes substantial cyclical variation in the rotational speed of the output spindle.

77. (previously presented) The power tool of claim 76 wherein said drive signal causes the motor to produce a series of torque bursts that drive the output spindle in a corresponding series of discontinuous rotational increments.

78. (previously presented) The power tool of claim 77 wherein each of said rotational increments is less than a full revolution of the output spindle.

79. (previously presented) The power tool of claim 76 wherein said control circuit is further adapted to produce a drive signal that causes the motor to drive the output spindle in a continuous rotational mode wherein the rotational speed of the motor is varied in accordance with an operating characteristic of the drive signal.

80. (previously presented) The power tool of claim 79 further including an operator actuable switch for selectively switching the control circuit between said pulse mode and said continuous rotational mode.

Respectfully submitted,

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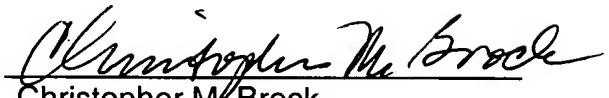
By: 
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